AGRICULTURAL
Research

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Research and Rural Development

Rural areas development has always been one objective of agricultural research. ARS is now placing added emphasis on research assistance in the development of rural areas.

Through a broad-scale effort, current studies—and a great reservoir of past research—are being related directly to the needs of specific communities.

A good example of this is research that backs up the small watershed program, important in the development of many rural areas. ARS is supplying information needed at the local level for planning the most efficient use of soil and water resources of entire watersheds.

Hydrologic studies are determining the effects of various land treatments on streamflow. Combined with basic research on soil erosion and sediment movement in streams, these studies are providing information on how to minimize the clogging of downstreams valleys with sediment and the flooding of urban, industrial, agricultural, and recreational areas. Still other studies are improving the accuracy of streamflow forecasting, so that major flood-retarding structures can be designed and operated efficiently.

Home economics research is making a direct contribution through rural home surveys to pinpoint economic problems. Utilization research designed to gain new industrial markets for farm commodities looks particularly promising—and is already paying off.

The poultry industry, for example, once paid up to $20 a ton just to dispose of waste feathers. Utilization research found a way to convert the feathers into a meal for use as fertilizer, an ingredient in plastics, and a nutrient in mixed feed. Now selling for about $100 a ton, feather meal provides $12 million of gross income to poultry processors and employment for at least 250 people in jobs created in rural areas.

About 170 alfalfa dehydrating companies now stabilize valuable nutrients of alfalfa and other forages through a method developed by utilization research. The use of dehydrated alfalfa is increasing at a rate of 40,000 tons a year, adding to farm income and creating about a hundred new jobs annually.

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Orville L. Freeman, Secretary,
U.S. Department of Agriculture

B. T. Shaw, Administrator,
Agricultural Research Service

FORECASTING PLANT GROWTH

Growth rate tells how much water or fertilizer to apply, and when

Researchers related leaf growth rate of tephrosia to environmental factors.

■ What makes a plant grow?

Scientists have long sought a way to predict the rate of crop growth with reasonable accuracy. Knowing that plants respond to environmental factors such as moisture, day length, or soil nutrients, ARS scientists set out to learn if these responses could be used to predict plant growth. They have come up with a formula that apparently does the trick.

This formula, developed by plant physiologists J. J. Higgins and J. R. Haun and biometrician E. J. Koch, measures the relative importance of each environmental influence on the growth of a plant. The scientists have used the formula to measure four influences known to have a powerful effect on plant development: temperature, available moisture, light intensity, and day length. It could be used with equal success, they say, to calculate the importance of any environmental influence—for example, the role of nutrients applied collectively or individually. This information, in turn, could be used to determine how much fertilizer a crop needs and when to apply it for best results.

The new formula, which is remarkably accurate, is based on the relationship between leaf development and a given environmental factor. It was worked out with data obtained in field trials with farm crops at the Plant Introduction Station, Glenn Dale, Md.

A mathematical equation is employed to predict the rate at which a plant will grow during any month of the season. The prediction is made in terms of the relative contribution of each environmental factor for a specific month.

The formula could be applied to a local area or farm, the researchers say, particularly through a farm service organization. Necessary information on temperatures and day lengths is available through local weather stations. However, special equipment would be needed in most cases to obtain data on light intensity and available soil moisture.

Four plants used in field trials

Field trials leading to development of the equation were conducted on corn, kenaf (an experimental fiber crop), crambe (a potential source of valuable industrial oil), and tephrosia (under study as a source of the insecticide rotenone).

The Higgins-Haun-Koch formula is expected to have wide practical application in agriculture. It would be of great value to a grower in telling him just when to apply irrigation water or fertilizer and how much to apply. In many seasons, he would be able to conserve water or fertilizer and the labor of applying them.

The formula could also be used to measure the environmental responses of important crops grown in the United States as well as new crops of potential value to U.S. agriculture. For example, scientists could predict precisely which crops would respond best to the varying environments of major growing areas of this country.

The team first proved a new method for making a daily record of plant growth by observing the structural changes in a leaf as it unfolds. These changes were recorded as tenths of the total process of leaf unfolding. Thus, in one set of readings, the daily rate of development for kenaf ranged from a little more than 0.3 of a leaf on slow days to more than 0.7 of a leaf on days of rapid growth.

Simultaneously, daily observations (throughout the 1961 and 1962 growing seasons) were recorded for average temperature, soil moisture content (by weight), day length, and light intensity (as measured by U.S. Weather Bureau solar radiation readings).

Correlating the records of leaf development and environment made it clear that there is a close relationship between plant growth and these major environmental influences. When the temperature climbed for several days, the rate of kenaf development increased; when temperature dropped, the plant growth rate dropped. Day length was important to kenaf in June and September, less so in July and August.

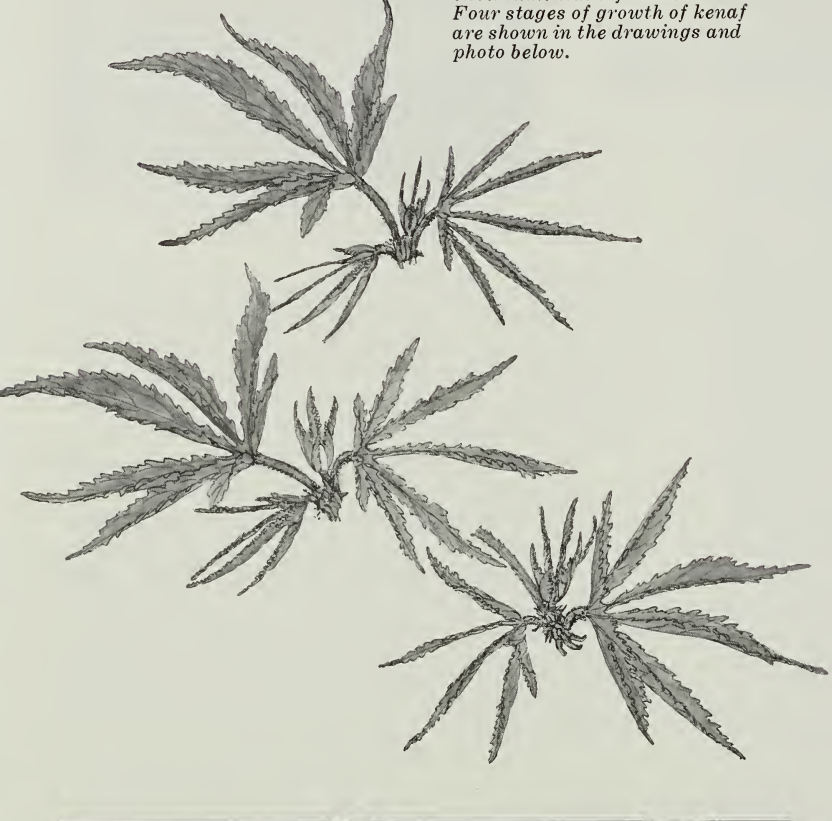
Comparing the plant growth rate

Turn page

PLANT GROWTH

(*Continued*)

Scientists observed the unfolding leaves of tephrosia, kenaf, crambe, and corn, then related growth rates to environmental influences. Four stages of growth of kenaf are shown in the drawings and photo below.



with environmental data also showed other things: On some days the relationship between the two was apparently inconsistent or erratic; an environmental influence was greater on some days than on others; obvious lag exists in the plant's response to an environmental factor, the amount of lag apparently varying from month to month.

The scientists then used electronic computers to statistically analyze the data on plant growth response and on the environmental factors. The result was a series of figures that provided a mathematical measure of the probable amount of influence each factor has every day on each crop. In addition, the statistical analysis provided a measure of the amount of influence of each factor for 1, 2, 3, 4, and 5 days previous to a specified day of recorded plant growth rate. The analysis also accounted for the amount of lag between influence and plant response for the whole growing season.

Thousands of computations were made to provide the mathematical evaluation of the importance of environment. Without the electronic computers, it would have been impractical, perhaps impossible, to attempt making them all.

To test the accuracy of the statistical results, the scientists plotted the expected development of kenaf at Glenn Dale for June, July, August, and September of 1962. Against this set of predictions, they recorded the actual growth record of test plants on a simple linear graph. The two lines exhibited a startling parallel course throughout the season.

The close statistical correlation between leaf development and environmental factors in this graph clearly demonstrates the value of the method. Future research is needed to refine the technique by making more frequent observations as well as to improve instruments for measuring environmental factors, the scientists say.☆

BLOOD TYPING AND CATTLE BREEDING

Genetic deviation indicates link between blood type and breeding failures

■ A genetic deviation from Mendel's law, discovered by ARS and Ohio scientists, indicates that blood types might be useful in selecting livestock for desirable reproductive characteristics.

Results of a dairy cattle study—in cooperation with the Ohio Agricultural Experiment Station—suggest that mating cattle of one blood type (FV) to cattle having a variation of the same type (FF) may account for some conception failures.

The study was conducted at Columbus, Ohio, by dairy husbandmen A. K. Fowler, T. M. Ludwick, D. F. Weseli, and C. H. Hines of the experiment station staff, and dairy husbandmen D. O. Richardson, E. W. Brum, and R. R. Rader of ARS.

Scientists have often speculated about potential uses for blood typing in livestock breeding. One important use would be in selecting for higher milk yields. So far, however, no relationships between an animal's blood type and its ability to produce have been found of great enough magnitude to be useful in selection. If such relationships are found, blood typing will become increasingly important. It already is providing valuable information.

For example, dairy bulls used for artificial insemination are blood typed so that breeders can determine the parentage of calves from cows inseminated by more than one bull. Typing also helps scientists distinguish between identical and fraternal twin calves used in research.

The possibility of any two cows, other than identical twins, having identical blood types is quite remote. Blood types in cattle are based on the existence of more than 50 antigenic factors—which can be brought together in millions of distinct combinations (Agr. Res., September 1957, p. 8). Each combination constitutes a separate blood type and can be categorized into 1 of 11 systems of blood-type inheritance.

The ARS and Ohio scientists discovered a pronounced genetic deviation from Mendel's law in one of these systems in dairy cattle.

The researchers studied five cattle blood-type systems (A, F–V, L, S, and Z) by tracing inheritance patterns from parent to offspring in a large number of cattle. All systems showed expected patterns of inheritance according to Mendel's law—except the F–V system.

In the F–V system, the scientists explain, an animal's blood may have a pair of F antigenic factors (FF), a pair of V factors (VV), or a pair consisting of an F factor and a V factor (FV). The factors are passed on genetically; each calf gets one factor from each parent to make up a new pair.

Thus, one parent typing FV will give an F or a V to its calf. The other parent, with the factors FF, will give only an F to the calf. And, theoretically, the calf stands as good a chance of having FV factors in its blood as FF's.

In checking 1,124 calves of FV and FF parents, however, the researchers found that only 511 had FV factors; the other 613 had FF factors. Theoretically, the numbers should have been equal. Mathematical odds are 200 to 1 that this deviation from the expected 50–50 ratio was due to something other than chance.

The unequal ratio of inheritance indicates a possibility of some kind of genetic antagonism, which may have an effect on embryonic loss when FV and FF cattle are mated. As a check to determine if these FV–FF matings affect reproductive performance, the scientists compared them with FF–FF matings.

The comparisons of reproductive performance failed to reveal any statistically meaningful differences in the number of matings required per conception or in the number of calves born. However, delays in returning to heat were slightly more frequent among the females in the FV–FF matings than in the FF–FF matings.

The scientists also checked the inheritance pattern when parents carrying only the FV factors were mated. According to Mendel's law, 25 percent of the offspring of FF–FF matings would be FF, 50 percent FV, and 25 percent VV. The check revealed no meaningful deviations from this expected ratio.

Therefore, FV–FF matings were the only ones in the FV system of blood typing that differed from expectations. Further studies are being planned to determine more fully what effect this genetic deviation has on reproduction.☆

IRRADIATION

A sterilization weapon against the corn borer

■ Research entomologists—encouraged by successful eradication and control of the screwworm and melon fly through the mass release of flies made sterile by radiation—are investigating this tactic as a potential weapon against another serious agricultural pest, the European corn borer.

Although corn borer damage in recent years has taken a consistent downward trend, it still is substantial enough to keep this pest high on the list of agriculture's insect enemies. Last year, corn borer damages were estimated at $94 million.

ARS entomologists J. R. Walker and T. A. Brindley conducted irradiation tests, using X-rays on laboratory populations, at the Corn Borer Research Laboratory, Ankeny, Iowa, in cooperation with the Iowa Agricultural Experiment Station. After irradiation, the corn borers were placed into egg-laying cages for study. The entomologists found that—

- Adult male corn borers were sterilized by doses of 32,000 roentgens of X-ray applied 1 day after emergence.
- At this dosage level, only 1 percent or less of the eggs hatched when the sterile males were mated with untreated females.
- Sterile males competed successfully with normal males for untreated females.
- Sterile males lived about as long as untreated males, suggesting that their survival in the field might compare favorably with that of normal males.

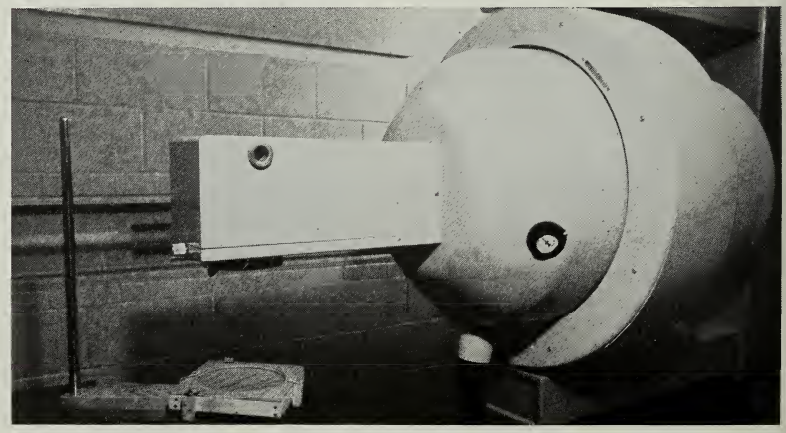
However, there was an indication that sterile males of the European corn borer might not be as successful as sterile male screwworms in competing with normal males. For example, when sterile corn borer males outnumbered untreated males 2 to 1, about 40 percent of the eggs resulting from matings with untreated females hatched. However, in experiments involving the screwworm, the same ratio reduced the egg hatch to 35 percent.

Tests were also run on the breeding performance of corn borers irradiated as pupae. These showed that the percentage of egg hatch varied with the age of pupae at time of treatment, the younger pupae being more susceptible to irradiation. And while the fertility of both sexes decreased as radiation dosage increased, female pupae were affected more.

Deformities were a problem—reaching a rate of 50 percent—when pupae under 24 hours old were irradiated with 5,000 roentgens. This was remedied by withholding treatment until pupae were 48 hours old.

The scientists used X-ray as the source of radiation for these studies, rather than the cobalt 60 treatment employed against the screwworm and the melon fly.☆

The entomologists sterilized corn borers by irradiating pupae with this X-ray unit. The younger pupae proved more susceptible to irradiation.



HAY WAFERING

Engineers study drying, handling of wafers in various types of storage

■ Cattle will eat more forage in wafer form than as loose or baled hay, and hay stored as wafers takes up only about half as much space as baled hay.

However, wafers are difficult to make and to handle, and, in humid areas, they must be dried before being stored. To overcome these difficulties, ARS agricultural engineers at Beltsville, Md., have been studying wafering by compression. Here are some of the things they have learned:

- A uniform stand of young, leafy legumes makes the best wafers.
- Harvested forage must have less than 17 percent moisture before it goes into the wafering machine.
- Water must be added to the forage during the wafering process.
- Finished wafers must be dried to less than 15 percent moisture for safe storage.
- Wafers are difficult to handle manually, and they do not "flow" easily.

Engineers R. D. Holdren, J. R. Menear, and J. R. McCalmont have been concentrating on drying, storing, and handling of wafers. To do this, they built several storage and drying bins and filled each with freshly made wafers.

In two structures—a corn crib and a simulated haymow—wafers became moldy when stored without drying.

In two plywood bins, 4 by 8 by 12 feet, air was forced through the bottom, using heated air for one bin and unheated for the other. In the bin getting unheated air, the wafers dried too slowly and after 19 days most of them had spoiled. Wafers dried with heated air did not mold, but they were very brittle from overdrying.

In a fifth structure—a round, steel bin—wafers were dried by using heat to keep the relative humidity in the bin below 60 percent. After 12 days in this environment, the wafers were considered safe for storage and no additional heat was used. After several months, these wafers were still in good condition.

The engineers learned that wafers will not dry enough in a few hours to keep safely in storage. They exposed a wagon load of wafers, for example, to heated air for about 2 hours. The wafers dried only on the surface, and within 6 days most of them were covered with mold.

Handling must be mechanized

Wafer handling must be completely mechanized before it will offer a real advantage over handling bales or other forms of forage.

The engineers are now developing methods and standards for measuring the physical quality of wafers. They are also studying the effects of crop maturity, particle size, and moisture on wafers, as well as the handling and storage of wafers of varying physical quality.☆

Wafers, made in this wafering machine, were stored and dried in various types of storage units, some equipped with air heaters to hasten drying.

Scientists study interaction between a plant pest and its host to find methods of controllin

SOYBEAN CYST NEM

■ Either the relative abundance or the kind of food supply available to the larva of the soybean cyst nematode may determine whether it develops into a male or a female. And the amount and kind of food are determined by the exact site in the soybean taproot where the nematode chances to feed.

ARS nematologist B. Y. Endo made this discovery in comprehensive studies of the interaction between the nematode and its host plant. Endo said this is one of the few instances found in which the nutritional environment influences the sex of an organism. His studies, in cooperation with the Tennessee Agricultural Experiment Station, are part of research aimed at finding improved methods of controlling soybean cyst nematodes.

Endo found that larvae which penetrated the cortex (outer layer) of the root and began feeding near protophloem tissue (which conveys organic material mostly downward in the plant) developed into males. In contrast, larvae that fed near the protoxylem tissue (which conveys inorganic material mostly upward) developed into females. These two sites are at approximately the same depth in the root's central core (stele), and are radially arranged very close together.

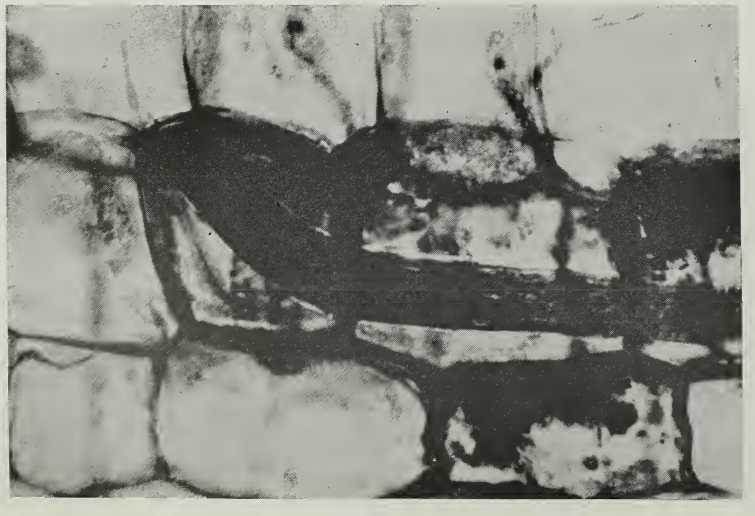
Others report high male ratio

The scientist believes that this example of sex determination may be related either to the relative abundance or the kind of food supply available at the two different feeding sites. Scientists working with other species of nematodes have reported a high proportion of male development in their experiments with heavily infected plants.

For its food supply, Endo has learned, the nematode depends upon development in the soybean root of a syncytium—a clump of plant cells whose walls have been broken down by a secretion injected by the nematode.

Syncytia associated with males were relatively small. They developed just outside the protophloem and were restricted mainly to the single-layered tissue of the pericycle (outer cell layer of the stele). Syncytia associated with females were larger. They formed near the protoxylem poles (where the lateral roots commonly develop), incorporating a multilayered pericyclic tissue and also involving the secondary cambium.

This nematode is penetrating soybean root cells with its stylet to inject a secretion that breaks down cell walls and forms a feeding reservoir.



Syncytia damage soybeans

One major result of the development of syncytia—which can be thought of as feeding reservoirs for the soybean cyst nematodes—is restricted growth of conductive tissues necessary for development of the plant. Consequently, syncytia greatly reduce the growth and yield of soybeans, especially when soil moisture is restricted.

May lead to secondary infection

As the nematodes mature, the syncytia shrink in size and often the syncytial walls collapse, leaving gaps in the plant root and cavities surrounded by dead plant tissue. These gaps may open the way for secondary infection

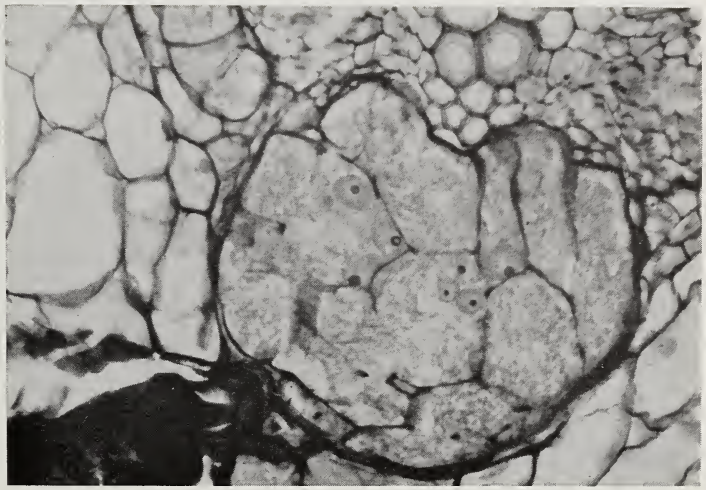
TODES

The nematode has penetrated deeply into this soybean root 24 hours after the root was inoculated with larvae.

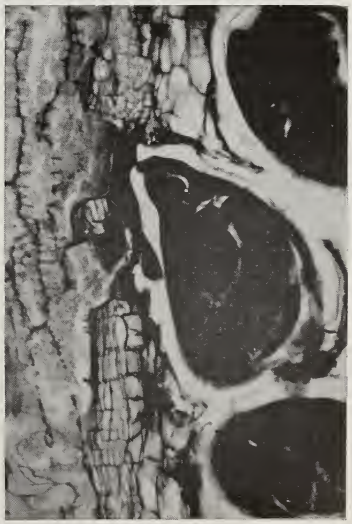
by other organisms.

Endo used the soybean variety Lee in his experiments. Seeds were germinated and seedlings grown in nutrient solutions; then the roots were inoculated with second-stage soybean cyst nematode larvae.

During the first 6 days, root samples were taken daily. From these, both cross and longitudinal sections were taken for microscropic examination. During the next 30 days, samples were taken at 3-day intervals. Final samples were taken 40 days after inoculation.☆



ABOVE—Cell walls have broken down to form this syncytium (feeding reservoir) 9 days after the soybean root was infected with larvae. Nuclei of the cells are visible in the syncytium, and the nematode is feeding at lower left. BELOW—A fourth-stage male larva (left) is shaped like an eel; the female (right) is oval shaped.



WATER HARVESTING

Engineers test ground coverings that collect rainfall for livestock

■ "Within the next few years, water-harvesting treatments will be developed that will supply water for livestock at a cost of only 36 cents per thousand gallons at locations with 10 inches of annual precipitation," predicts L. E. Myers, director of the U.S. Water Conservation Laboratory, Tempe, Ariz. In a 20-inch precipitation zone, the cost should be no more than 18 cents per 1,000 gallons.

Better use of grazing area

These low-cost installations could be built by stockmen in arid and semi-arid locations in the West, where grazing land often is not fully utilized because there is no dependable water supply.

Several promising—and economical—experimental methods for harvesting water have been developed by ARS agricultural engineers at Tempe and are being tested through several seasons.

Water harvesting is the collection of water from an area where soil has been treated to increase rainfall runoff. In arid locations, it conserves moisture that otherwise evaporates from bare soil or is transpired by nonbeneficial vegetation. Runoff collected for livestock is held behind dams, in tanks, or in butyl-coated nylon bags.

Eventually, Myers forecasts, water harvesting will be widely used to develop added municipal, industrial, and agricultural water supplies (AGR. RES., May 1962, p. 6). Treated areas could be established on lands with little or no value for domestic animals or wildlife, and the collected water could be stored in reservoirs or natural underground sites.

Rainfall collection was practiced 4,000 years ago on the Negev Desert, and a more modern example is the use of cisterns to collect and store runoff from rooftops.

ARS soil scientist C. W. Lauritzen found in earlier research that artificial rubber sheeting and asphalt-coated jute fabric are highly effective for collecting precipitation (AGR. RES., March 1961, p. 6). He also developed a butyl-coated nylon bag to eliminate evaporation and seepage of the collected water.

Agricultural engineers at the Tempe laboratory reasoned that materials sprayed on the soil to make it impervious to water should be even less expensive than rubber or coated jute.

Initial research with standard anionic asphalt emulsions showed that they did not readily penetrate and bond to clay soils, although the installation cost was low. Most soil surfaces carry negative electrical charges, and the anionic emulsions—also negatively charged—were repelled.

The researchers then turned to cationic asphalt emulsions, which carry positive electrical charges and develop a tight chemical bond with the soil surface. But the speed of the bonding action was a liability; the emulsion bonded before penetrating deep enough into the soil to form a lasting cover. The engineers overcame this difficulty by temporarily halting the bonding process until the asphalt penetrated a desired half inch or more into the soil.

Dual treatments still better

Even more promising are treatments in which cationic asphalt emulsions were combined with ground covers of aluminum foil, synthetic rubber, or plastic film. The cationic emulsions bond as well to these materials as to soil.

The engineers anchored a 2,500-square-foot sheet of butyl rubber to

This high-capacity spray boom applies low-cost waterproofing and stabilizing materials to soil. Increased rainfall runoff can then be channeled into storage equipment for use by livestock.

the soil with cationic emulsions to prevent billowing of the rubber sheet by wind. The installation was made in warm weather, and the treated area was still capturing almost 100 percent of the runoff 2 years later. Polyethylene has been similarly bonded to soil in small plots.

Aluminum foil and asphalt

In another experiment, asphalt emulsion was sprayed on the soil surface, and 1-mil aluminum foil was unrolled from a spindle in strips 4 feet wide. A foam-rubber roller, mounted behind the spindle, pressed the metal sheet against the emulsion-coated soil. Fiberglass reinforcing was added in some treatments. When properly installed, the foil-asphalt cover is durable and collects essentially 100 percent of runoff from rainfall.

The initial cost of these experimental treatments—including site preparation, materials, and installation on small plots—ranges from a high of about 45 cents per square yard for the foil-asphalt with fiberglass down to a low of about 10 cents per square yard for polyethylene and asphalt emulsions. Annual repairs and periodic replacement will cost 3 to 5 cents per square yard. These estimates include considerable hand labor.

Myers says that the annual cost should be less than 2 cents per square yard on larger areas, where application could be more completely mechanized.☆

NEW TECHNIQUES TO...

Improve Survival Rates of Shelterbelt Conifers

■ Several simple, inexpensive nursery treatments can improve the survival rate of evergreen seedlings grown for shelterbelts under the rigorous conditions in the Great Plains.

ARS research forester E. J. George has conducted long-term studies of treatments that include (1) undercutting seedling taproots to help trees develop a branching root system, (2) dipping the seedling tops in wax emulsion or clipping back needles to reduce moisture loss from leaf surfaces, (3) applying limited amounts of nitrogen fertilizer to seedling plantings, and (4) potting seedlings.

Survival of evergreen transplants is low in the Great Plains unless special precautions are taken to protect the young trees. This is because of the region's low annual rainfall, strong drying winds, and high summer temperatures. But once established, evergreens are highly desirable for windbreaks.

George has tested 36 different treatments for transplants during the 22-year study at USDA's Northern Great Plains Field Station, Mandan, N. Dak. He found that 19 of the treatments gave survival rates ranging between 80 and 100 percent. A survival rate of 80 percent or better is satisfactory.

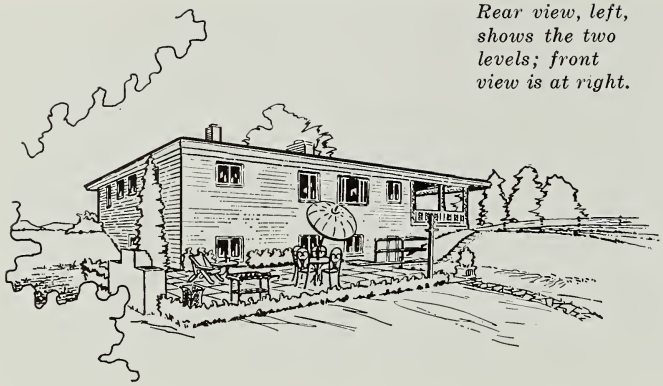
Without any protective treatment, the survival rate of evergreen plantings on western North Dakota farms was less than 39 percent for ponderosa pine and less than 57 percent for Colorado spruce.

In George's tests, taproot undercutting was tried for 2 years on ponderosa pine and Colorado spruce transplants. The survival rate of the pines was 100 percent the first year, 98 percent the second year; the rate for Colorado spruce, 94 percent the first year, 100 percent the second. High survival rates were also gained by dipping tops of the transplants into two different commercial wax emulsions to prevent moisture loss. All treated trees survived in experiments with both ponderosa pine and Colorado spruce. Among the control transplants, 73 percent of the spruces and 94 percent of the pines survived.

Clipping back the needles proved a highly satisfactory treatment for ponderosa pine and Rocky Mountain juniper. On the pines, George tried clipping back the needles both one-half and three-fourths of their full length. The needles of the juniper transplants were trimmed back only one-half of their length. Survival rates were 100 percent for the ¾-clipped pine; 97 percent for the ½-clipped pine; and 95 percent for the ½-clipped juniper.

Survival rates were also extremely high when limited amounts of nitrogen fertilizer were applied at planting time. This treatment was tried on ponderosa pine, Black Hills spruce, eastern redcedar, and Colorado spruce. Survival rates were well above 90 percent at application of 30 pounds or less to the acre. The 30-pound rate, however, caused burning and loss when rainfall was scarce in the period after the fertilizer was applied.

Survival rate was improved in nursery plots by growing the seedlings in 5- and 7-inch pots made of aluminum building paper, 7-inch pots of black building paper, and 7-inch wooden pots.☆



Rear view, left, shows the two levels; front view is at right.

FIVE-BEDROOM FARMHOUSE

Plus a fallout shelter

A two-level, five-bedroom farmhouse plan (No. 7153) that provides for a basement fallout shelter has been developed by engineers and housing specialists of ARS and 11 Western States.

On the main level, there are three bedrooms, two baths, a workroom, a U-shaped kitchen, a dining room, and a living room. The basement level has two bedrooms, a bath, a TV room, a recreation room with its own outside entrance, and a furnace-utility room.

Space is provided in one corner of the basement for a fallout shelter that can also be used to store canned goods. If the fallout shelter is to be built in the basement, the engineers suggest incorporating USDA Plan No. 7166, "Fallout Shelter for Six People," which was designed for this house.

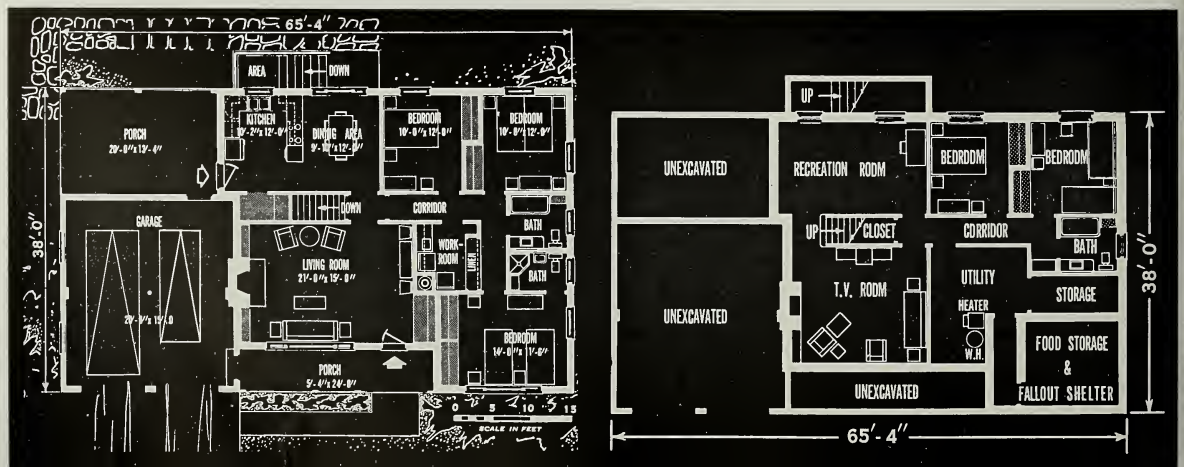
At one end of the spacious 21- by 15-foot living room is a brick fireplace flanked by built-in shelves. The kitchen is separated from the dining room by an open counter.

A hall leads from the living and work areas to the sleeping area, where the master bedroom has two large closets and a private bath with an enclosed shower. Another bath is conveniently located near the other two bedrooms. Each bathroom has its own linen closet.

The centrally located workroom provides adequate space for a washer, dryer, and small sink with counter space. It has a large two-way linen closet located along one wall that makes it convenient to put away clean linens from the workroom side and remove them from the hall side—near the bedrooms—as they are needed.

Other storage space includes a closet by the kitchen for work clothes and cleaning equipment, a "lockup" closet in the basement TV room for safe storage of sport equipment, and

Top level (left) has three bedrooms; lower level has two.



a large coat closet just inside the front entrance.

A long front porch, set off by ornamental ironwork, is recessed between the bedroom wing and a two-car garage. A larger porch is located at the rear of the garage, just off the kitchen. This porch has an entrance into the garage and another into the kitchen.

The new farmhouse is a modification of a five-bedroom house built by W. B. Ringer, extension agricultural engineer of Utah State University. Ringer is a member of the Western Regional Plan Exchange Committee, which is made up of agricultural engineers and housing specialists of ARS and State universities in Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

Working drawings of Plan No. 7153, "5-Bedroom Farmhouse With Basement," and Plan No. 7166, "Fallout Shelter for Six People," are available from extension agricultural engineers at most State agricultural colleges. There is usually a small charge.☆

FUNGUS-DAMAGED COTTON FIBER...

Spins into yarn of satisfactory quality

■ Cotton blends containing as much as 5 percent of fungus-damaged fiber can be spun into yarn of satisfactory quality, although spinning performance is lowered, ARS research shows.

The spinning tests were conducted with cottons damaged by the fungi *Diplodia, Aspergillus flavus, Nigrospora,* and *Rhizopus,* which attack maturing cotton bolls in the field. These fungi are most prevalent in areas where high humidities and temperatures encourage their growth and spread.

Yarn quality, spinning breakage

In laboratory tests, cottons were processed into blends containing 2.5, 5, and 10 percent of the damaged lint by weight. Medium-sized yarns spun from blends containing 2.5 or 5 percent of fungus-damaged fibers did not differ significantly from yarns spun from undamaged cotton in uniformity, appearance, breaking strength, and elongation. Yarn breakage increased during spinning but remained within acceptable limits of 40 to 60 breaks per 1,000 spindle hours.

Blends containing 10 percent of damaged fibers also were spun into medium-sized yarns, but the number of breaks during spinning was excessive. ARS scientists believe, however, that a 10-percent blend could be used to spin larger sized yarns of satisfactory quality.

The investigations were carried out by L. A. Fiori, J. E. Sands, N. H. Groves, and W. G. Sloan, of the Southern utilization research laboratory at New Orleans, and P. B. Marsh, cotton physiologist at Beltsville, Md.

Whether it would be practicable to spin damaged-fiber blends commercially is a complex question, the scientists point out. For instance, the blends would have to be very closely controlled in mills because the percentage of fungus-damaged cotton varies from bale to bale.

Yarn blends tested in fabrics

Print cloth woven with filling yarns (yarns running the width of the fabric) that contained 5 percent of fungus-damaged cotton had quality characteristics comparable to fabrics woven with yarns spun from undamaged cotton. The test fabrics, which were woven in such a way as to expose most of the filling yarns on the face of the cloth, were evaluated for resistance to tearing and flex abrasion and for behavior in dyeing.

These fabric tests showed that the breaking strength of strips from the width of the fabric was about 45 pounds for blends containing 2.5- and 5-percent damaged fiber, compared with 47 pounds for the undamaged. One-inch strips containing these blends also differed little from the control in percentage of elongation before breaking. The blends averaged slightly more than 17-percent elongation-at-break, and the control averaged slightly more than 18 percent. Tearing strength for the two blends and the control averaged about 5 pounds.

All fabrics were finished

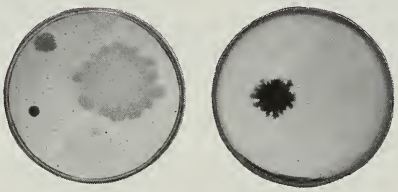
Samples of all the fabrics, including the control, were subjected to standard chemical finishing processes: desizing, scouring, mercerizing, and dyeing. The fabrics containing filling yarns spun from the 2.5-, 5-, and 10-percent blends dyed virtually the same shades as the fabric made entirely from the undamaged cotton.☆

LAUNDRY DISINFECTANTS

Normal home laundering does not destroy all disease organisms

■ Normal home-type laundering cannot be depended on to destroy or prevent the spread of many disease-producing organisms. An effective disinfectant is needed, especially in the case of sickness in the family or neighborhood—or if laundry is done in a coin-operated machine.

These conclusions come from a study by ARS textile bacteriologists Ethel McNeil and Eva A. Choper, who washed the naturally soiled laundry of nine families over a period of several months. The scientists determined the number of bacteria normally present during laundering when only detergent is added to the water in an automatic household washer.



A much larger population of bacteria developed in laundry water containing no disinfectant (far left) than in laundry water to which chlorine was added (left).

Textile bacteriologist Eva Choper uses a colony counter to determine the number of bacteria in wash and rinse water.

Hot water versus warm water

The bacterial count in the wash water varied from 80 to 84,000 bacteria per milliliter at the hot-water setting, and from 2,120 to 340,000 at the warm-water setting. The number of bacteria recovered from the rinse water ranged from 30 to 32,000 per ml. after hot-water washing, and from 870 to 41,000 per ml. after warm-water washing.

Evidence of bacteria passing from one article to another was obtained by attaching an unsoiled swatch of fabric to a soiled article of family laundry at the beginning of the wash cycle. The researchers recovered 200 to 22,250 bacteria per square inch from the swatches washed at the warm setting, which was relatively the same as the 50 to 25,000 per square inch at the hot-water setting.

The bacteriologists identified 30 kinds of bacteria from 400 cultures taken from the laundry of the cooperating families. The most important of these—from the standpoint of family health hazards—were *Staphylococcus aureus,* which may cause carbuncles, kidney infections, and pneumonia; *Pseudomonas aeruginosa* (green pus producer), which can cause skin lesions, genitourinary infection, and lung lesions; and *Paracolon* bacteria, some of which cause intestinal disturbances.

Bacteria and incidence of disease

Staphylococcus was found in the laundry of seven of the nine study families. In three of these seven families, at least one member had a skin or respiratory infection during the test period.

Pseudomonas was also found in the laundry of seven of the nine families. Members of three of these families had either ear or genitourinary infections during the test period. There were also several cases of intestinal upset, some of which may have been caused by *Paracolon* bacteria.

The researchers established that adding a chlorine (liquid chlorine bleach), a quarternary, a pine oil, or a phenolic disinfectant at some stage of laundering appreciably reduced the numbers of bacteria.

Previous research at the Beltsville laboratory had shown that disinfectants destroyed three kinds of test bacteria added on selected fabrics (AGR. RES., July 1961, p. 15). But the researchers needed to know whether the disinfectants were equally effective when used on naturally soiled clothing and what kinds of bacteria would be found on the clothing.☆

Heat processing of pickled foods

For the first time, ARS food specialists are recommending heat processing of all home-canned pickled fruits and vegetables *after* they are packed in jars.

Studies in the food quality laboratory at Beltsville, Md., show that pickled products packed in jars and heated in a boiling-water bath have higher quality and longer storage life at room temperatures than those made by open-kettle canning.

In-jar processing in boiling water achieves two purposes:

- Stops the action of peroxidase and other enzymes that can cause undesirable changes in texture, flavor, and color during storage.
- Destroys micro-organisms such as bacteria, yeasts, and molds that are likely to cause spoilage.

Pickled products are bacteriologically safe, researchers point out, as long as the acid content is high to begin with and remains high during storage. But yeasts and molds may start to grow within the jar of food and reduce the acid content. In the resulting low-acid environment, *botulinum* spores, if present, could start to grow and produce a deadly toxin that causes botulism. Adequate processing will destroy the spoilage micro-organisms, which may contaminate the pickles as they are packed in the jars.

Using heat-penetration measurements, microbiological examinations, chemical determinations, and taste-panel evaluations, the food specialists and bacteriologists developed heat-processing times and procedures suitable for home preservation of several popular pickled vegetables and fruits.

Further information is available in "Making Pickles and Relishes at Home" (CA No. 61–14, Revised 1963). Copies may be obtained from the Food Quality Laboratory, Agricultural Research Center, Beltsville, Md.

Key ARS appointments are made

Several appointments have been made in the ARS regulatory and control administrative staff and Animal Disease and Parasite Division.

R. J. Anderson, former assistant administrator of regulatory and control programs, was named deputy administrator to succeed W. L. Popham, who retired after more than 40 years with USDA.

E. P. Reagan, who had been director of the Plant Quarantine Division since 1954, has succeeded Anderson as assistant administrator.

C. A. Manthei has been made director of the National Animal Disease Laboratory, Ames, Iowa, after serving as assistant director since 1959. The former director of the laboratory, W. A. Hagan, died last February.

New data on foot-and-mouth disease

Foot-and-mouth disease can be transmitted in bull semen before an infected bull shows any signs of the disease. Use of this virus-contaminated semen for artificial insemination can cause the disease in cows.

These findings by ARS veterinarians at the Plum Island Animal Disease Laboratory, Long Island, N.Y., indicate that foot-and-mouth disease could be brought to U.S. livestock if semen were imported from countries where the disease exists. Such imports are now prohibited by USDA quarantine regulations.

Semen of bulls experimentally infected with the disease contains the virus as early as 12 hours after infection. Symptoms of the disease in cattle generally do not appear for at least 18 to 24 hours after infection.

Five out of 20 heifers artificially inseminated with semen from experimentally infected bulls contracted the disease.

Foot-and-mouth disease has been kept out of the United States since 1929, although it occurs in many countries of the world. This disease is highly contagious to livestock, and the Plum Island laboratory, off the northeastern coast of Long Island, is the only place in the United States where experiments with foot-and-mouth disease are permitted. The laboratory was established in 1954 to aid in USDA's efforts to keep foreign livestock diseases out of this country.

Potato resists leaf-roll virus

The first potato with good resistance to leaf-roll virus has been developed by ARS in cooperation with the Maine Agricultural Experiment Station.

This new variety—named Penobscot—has given satisfactory test yields and consistently high dry-matter content, in addition to showing much more leaf-roll resistance than commercial varieties now grown. It also has field immunity to mild mosaic.

Leaf roll, which is spread by aphid vectors, is a serious disease problem in some potato-growing areas. The leaf-roll-resistant potato has been tested only in Maine, Connecticut, Delaware, Massachusetts, and New

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Jersey, but future trials may widen the area of its adaptation.

Penobscot tubers are oblong to oval, with cream-buff skin and eyes of medium depth. They show good quality for processing into chips or french fried potatoes, both at harvesttime

and at intervals after storage.

The new potato was selected from a cross between the commercial variety Katahdin and an experimental seedling, X927–3, which has demonstrated resistance to leaf roll. A limited amount of certified seed was made available to growers through cooperating agencies this year for growing trials. USDA has no seed for distribution.

Step-on-mat controls spray

An important job on any dairy farm is controlling biting flies, which irritate dairy cows and cut milk production as much as 20 percent.

To save labor in applying insecticide—the only control method now available—dairymen often use automatic spraying devices that allow the cow to spray herself. Many automatic sprayers now in use are operated by a photoelectric cell, which triggers the sprayer as each animal passes through the light beam. Sometimes, however, spray drifts in front of the photo cell and causes the sprayer to continue operating after the cow has passed.

ARS agricultural engineer I. L. Berry and entomologist R. A. Hoffman have found that step-on-switch mats—like those that open doors at a supermarket—use less pesticide and require less maintenance than photoelectric cells.

Last year, Berry and Hoffman installed a switch mat in a spray chute on a dairy farm at Wharton, Tex. Cows passed through the chute when they left the milking parlor.

The sprayer provided complete control of horn flies and good control of stable and house flies. Less pesticide was used because the sprayer operated only while the animal was walking on the mat. The device was still in excellent condition after being stepped on 32,000 times by Holstein cows.

Berry says the cows were not afraid to walk on the mat because it was secure and flush with the ground. The switch was sealed under a piece of quarter-inch cardboard and rubber carpeting. Cattle are reluctant to step on treadles or platforms that move or are more than an inch or so above the ground.

Berry and Hoffman are stationed at USDA's Livestock Insect Laboratory, Kerrville, Tex.

Potatoes and chipping quality

Many varieties of potatoes, both commercial and experimental, have the inherent quality for processing into chips of good commercial color—but the managerial skill of growers and processors is often more important than the inheritance of the tuber for guaranteeing potato chips of good market color.

ARS research in cooperation with private industry has demonstrated the wide availability of genetic material that will produce tubers having good chipping quality. Tests showed that 180 out of 190 selected experimental potato lines produced chips of light, golden color when the tubers were processed into chips immediately after harvest.

In the same tests, tubers of 162 out of 190 lines produced high-quality chips after storage for several months at 45 degrees F. and reconditioning for 2 weeks before processing. Sixty of the 190 lines produced good chips after the same storage period at 38 degrees F. and the same 2-week reconditioning period.

Reconditioning in commercial practice consists of holding stored potatoes at 75 to 80 degrees F. for 2 weeks to reverse the conversion of starch to sugars, which occurs when potatoes are put in cold storage. Sugar buildup results in dark chips of unacceptable market quality.

The research was conducted by F. J. Stevenson, ARS geneticist (now retired), R. V. Akeley, ARS potato investigations leader, and C. E. Cunningham, a geneticist with private industry. Results were reported at the 13th Annual Potato Utilization Conference.